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Fuel Performance Enhancement by Varying Coefficient of Drag in A Current Automobile

Gyaneshwar Wagadre[1], Prof Kamlesh Gangrade[2]

[1] PG scholar, Department of Mechanical Engineering, SAGE University, Indore
[2] Assistant Professor, Department of Mechanical Engineering, SAGE University, Indore

ABSTRACT

In this study, we took a Volvo bus and attempted to make improvements to it in order to lessen aerodynamic drag and increase fuel efficiency. A Volvo bus is an excellent example of a product created by a global corporation that was also aerodynamics-optimized. Other locally constructed buses would most likely see a more significant improvement if we can achieve some improvement in the same identical adjustments. Bus operations use a significant amount of diesel in the nation (99.55%), thus even a minor increase in fuel economy will make a major difference.

Keywords- CFD (Computational Fluid Dynamics), Automotive Sector, Fuel Efficiency etc. Aerodynamics, Drag

1. INTRODUCTION

The fuel efficiency of a vehicle is critical in determining whether or not the vehicle will be successful in the marketplace. There are two reasons for this. To begin with, the cost of fuel in India is very high in dollar terms when compared to several other countries. Second, our currency is weaker, so we pay much more in purchasing power parity terms as Indians. As a result, our market is extremely sensitive to fuel costs per kilometre. We've all heard of Maruti Suzuki's "Kitna Deti Hai" campaign.It was a successful campaign that aided in increasing their sales. That is one of the reasons they have nearly a 50% market share in a market with more than 12 players.

The following factors influence a vehicle's emissions:

1. Road construction and maintenance.
2. Fuel Quality
3. People's Driving Habits
4. Vehicle maintenance
5. Automobile Design

2. PROBLEM IDENTIFICATION

There many reasons that affect the efficiency of the vehicle of a like efficiency of the power plant, weight, rolling resistance and aerodynamics of its design. Till now the buses were traveling at very slow speeds and thus the aerodynamics did not play significant role in determining their fuel efficiency. But, with road infrastructure being augmented at an unprecedented pace the scenario is going to change drastically and we will soon be seeing vehicles travelling at 140 Kms and more on Indian roadssoon.[13] Thus we can no more over look this aspect i.e., aerodynamics even in buses.

3. OBJECTIVES

The main objectives in this research work are

- **Improve fuel efficiency of a bus by reducing aerodynamic drag.**
- **Improve the profitability of bus operators**
- **Improve the comfort for passengers**
- **Reduce green-house emission.**

4. METHODOLOGY

Figure 4.1 Methodology

5. CFD ANALYSIS

In this research work firstly we performed the analysis on fundamental concept design then existing vehicle design, conclude the data and suggest the design modifications.

Design 1 (Original Volvo Bus)

We made the initial design taking inspiration from an actual Volvo bus.

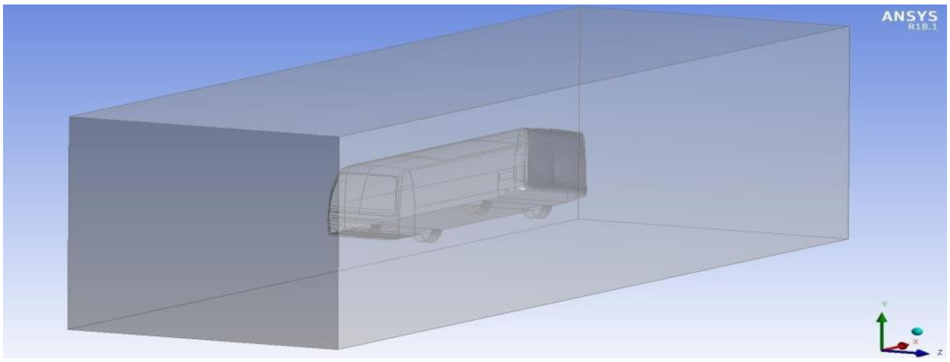

Fig.5.1 Design 1

Results – Drag Coefficient – 0.35904 and Drag Force – 2.010

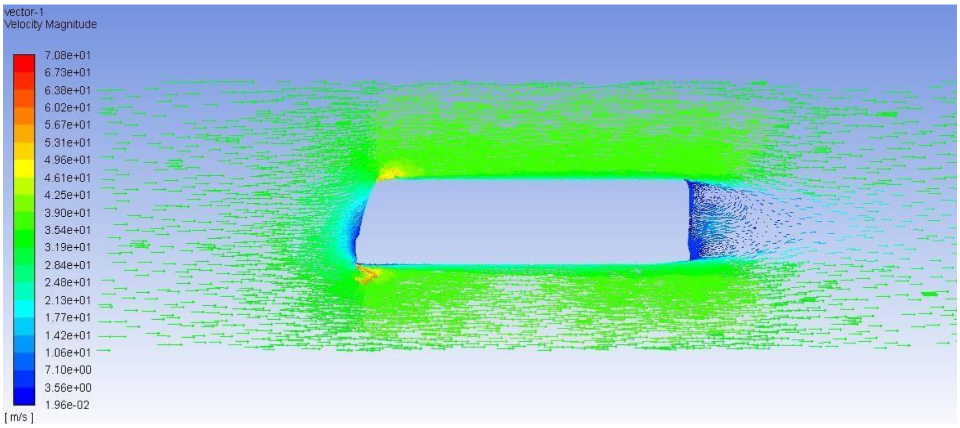

Fig.5.2 Velocity Results

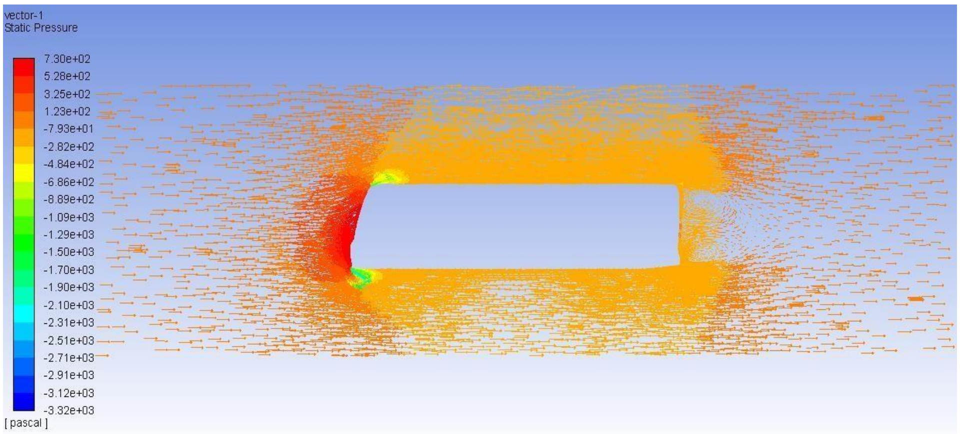

Fig.5.3 Pressure Results

Design 2 – We gave it an oval shape, gave a taper at the top and ran the design in the Ansys Fluent

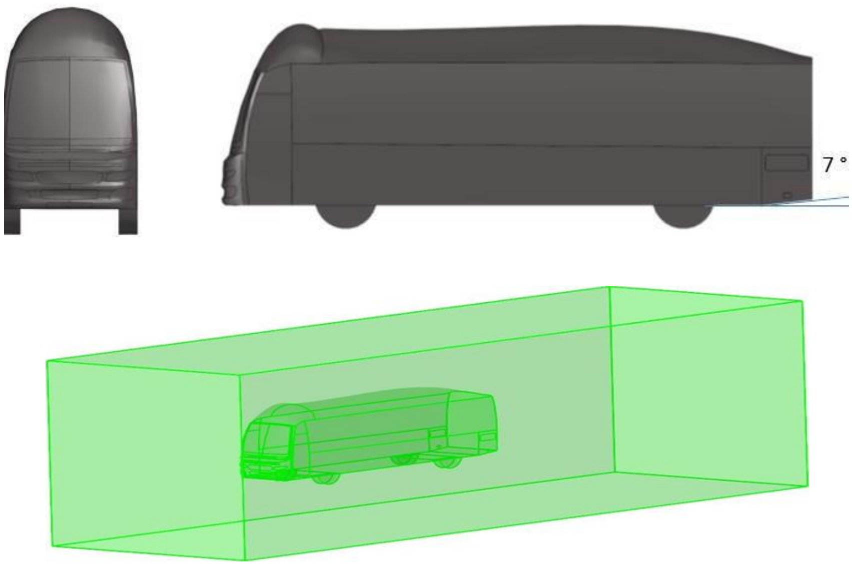

Fig.5.4 Design 2

Results – Drag Coefficient – 0.38193 and Drag Force – 2.5353

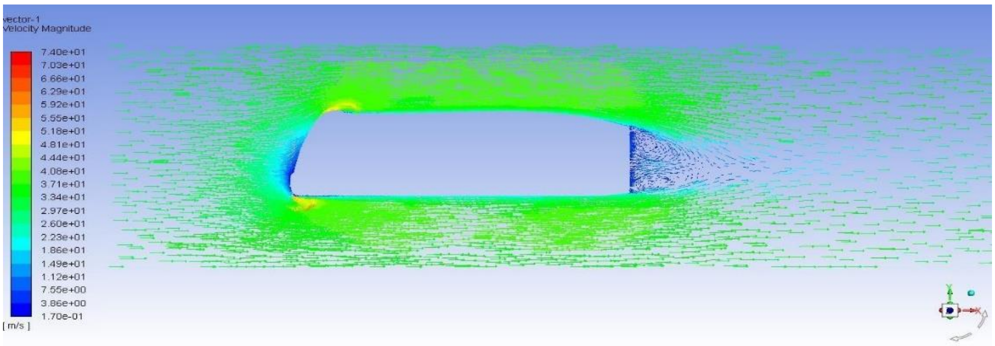

Fig.5.5 Velocity Results

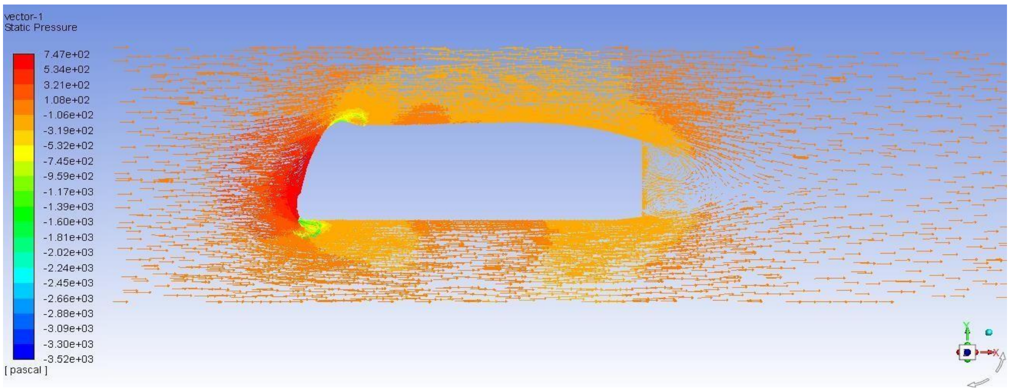

Fig.5.6 Pressure Results

Design 3 – Another iteration we tried was by increasing the angle of departure 17°

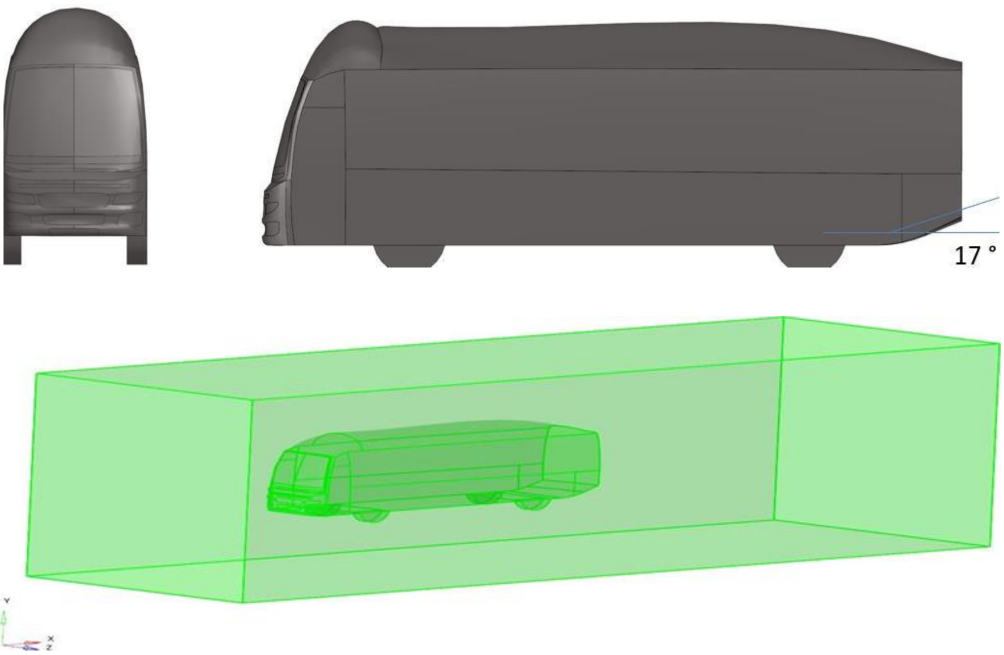

Fig.5.7 Design 3

Results – Drag Coefficient – 0.38360 and Drag Force – 2.5231

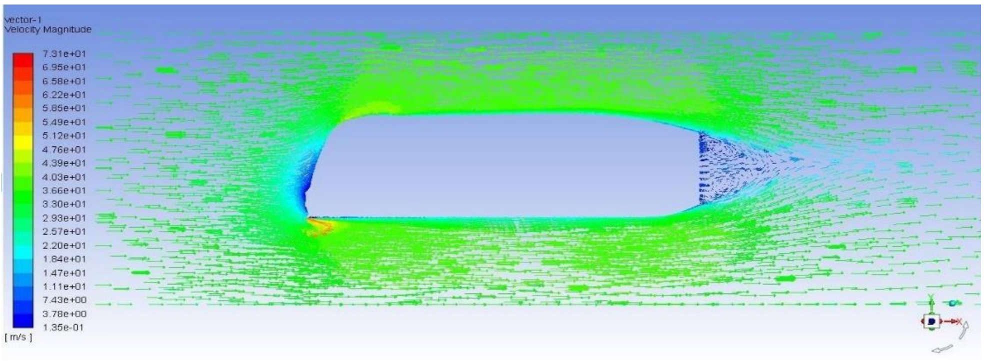

Fig.5.8 Velocity Results

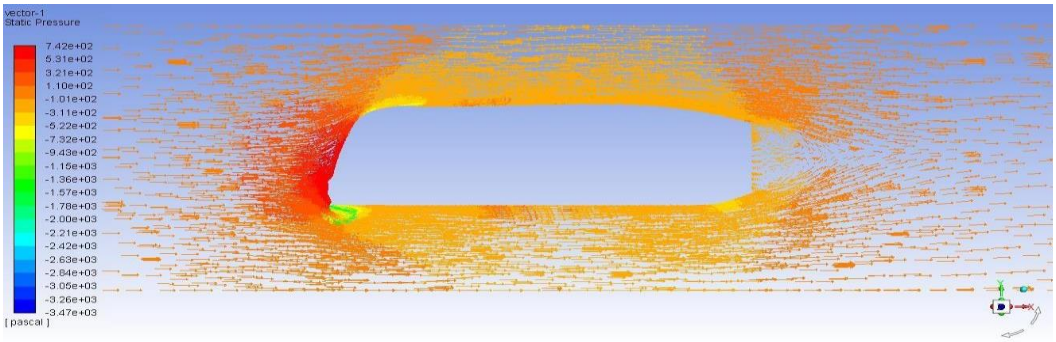

Fig.5.9 Pressure Results

6. CONCLUSION

The goal of this study was to improve an automobile's efficiency by lowering the drag force generated by aerodynamic forces. as speeds increase, aerodynamics become more important. This is because drag is proportional to the square of velocity, whereas other factors such as area, Cd, and air density only have a linear relationship. We can easily predict drag coefficient and lift value in computational fluid dynamics analysis, which aids the engineering team in designing the aerodynamic shape of the vehicle. Thus, various shapes were tried to find the most optimum one which will reduce the aerodynamic drag to a bare minimum.

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